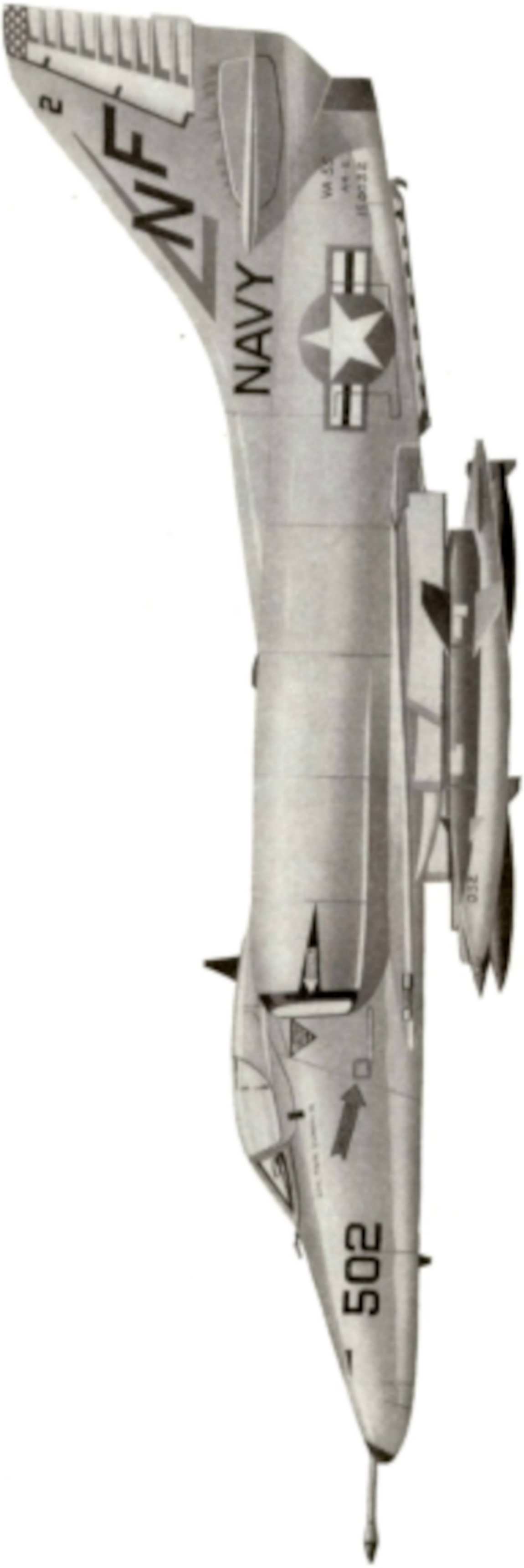
PROFILE
PUBLICATIONS

The Douglas A-4 Skyhawk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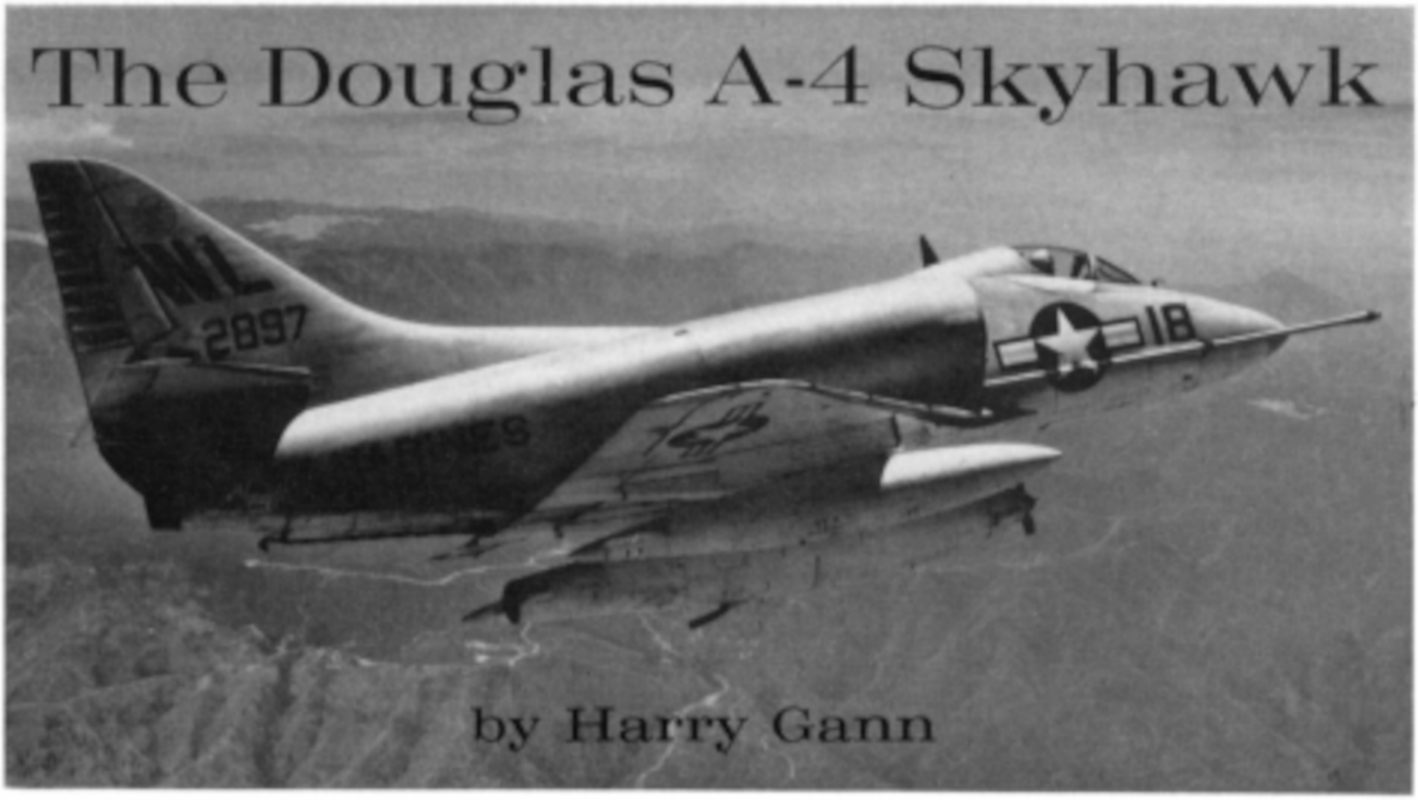
TWO SHILLINGS

The Douglas A-4 Skyhawk

by Harry Gann



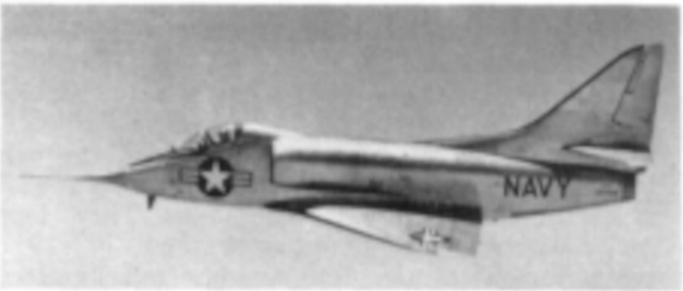
The Douglas-developed buddy system of inflight refuelling store is shown on this A4D-2 of VMA-311. (Photo: via the author)

The A-4 Skyhawk was born as a result of three unrelated circumstances occuring in the early part of the 1950's. Top Douglas engineers began worrying about the growing complexities and resulting cost of combat aircraft: an operational requirement was being generated in the fleet for an attack aircraft that could fly the same mission as the propeller-driven aircraft but in less time thus saving fatigue: a contemporary turbo-prop powered aircraft was in trouble as a result of engine control problems.

Studies of the weight growth, cost, reliability intermix by Douglas conclusively showed the advisability of making the detail designer weight conscious for it was found that a growth factor of about ten could be expected for a contemporary combat aircraft. This means that if a given performance criteria was to be met, the addition of one pound of weight in any form would result in an overall increase of ten pounds of structure and fuel. With these concepts in mind, a fighter design was presented to the U.S. Navy for consideration in early 1952. In view of the inputs from operation fleet squadrons requesting an improved attack aircraft, the Navy suggested a redirection of the Douglas proposal to encompass these attack requirements.

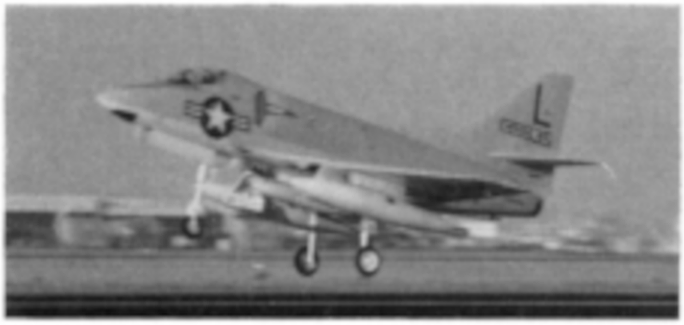
Funds became available to convert the proposal to hardware when the decision was made to scrap the Douglas A2D turbo-prop attack aircraft because of the apparently unsolvable engine problems. The contract was let on June 21st 1952 for "a light weight, single engine, single place, high performance, carrier based, day attack landplane capable of performing dive bombing, interdiction and close support missions." In addition it was to be—"capable of delivering conventional or special weapons and intended to be capable of striking sea and land targets with or without fighter escort where control of the air had not been established." Thus, the Skyhawk seed had been planted.

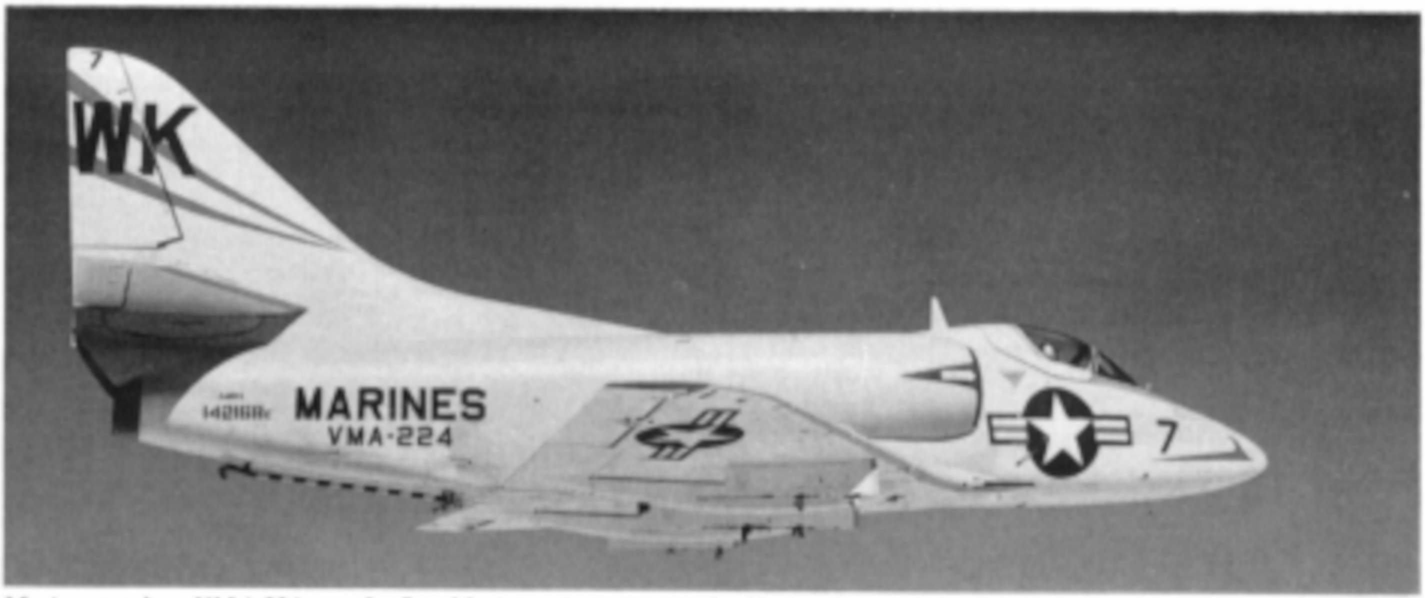
By October of 1952, the mock-up board had met, evaluated the design, suggested some alterations and two contracts for a total of 19 aircraft had been signed. On June 22nd 1954, Test Pilot Bob Rahn made the first flight of the number one aircraft, Bu No. 137812. Two years of intensive flight tests, both by Douglas and the Navy test pilots followed, to prove the aircraft and all of its systems to be ready for the rugged use that the fleet squadrons would soon place on it. During this test program, Lieutenant Gordan Grey of the Navy test team verified that the speed performance was adequate by speeding to a new five hundred kilometer close-course record in airplane Bu No. 137814 of 695·163 m.p.h., the first attack aircraft to hold this record. This



First flight of the XA4D-1 was made on June 22nd, 1954 by test pilot Bob Rahn. Subsequently, the X designation was dropped and BuNo 137812 became A4D-1. In later life, this aircraft became the mock-up for later versions.

First factory to fleet delivery of the Skyhawk was accomplished in October, 1956 with VA-72 the receiving squadron.
(Photo: Douglas)





Marine squadron VMA-224 was the first Marine unit to operate the Skyhawk. (Photo: Douglas)

record was set at an altitude of 100 metres (328 feet) October 15th 1955 and has not yet been broken at low altitude. In October of 1956, the VA-72 received the first factory to fleet delivery after serving as the service test unit for the F.I.P. (Fleet Indoctrination Program) trials. Deliveries accelerated and soon all jet attack squadrons in the Navy and Marines were flying A-4 aircraft. The production run of A-4A aircraft was 166 aircraft.

Even before the fleet deliveries of the A-4A aircraft began, orders were placed for an improved version, the A-4B. The A-4B or the A4D-2 as it was initially designated, differed from its predecessor by having an improved bomb delivery system, Bullpup air-to-ground capability, an automatic dead reckoning navigation computer, inflight refuelling capability as both receiver and tanker, and a dual hydraulic system. The rudder was stiffened by fabricating it "inside out" i.e., external stiffeners and an internal surface or skin. This "tadpole" rudder, as it was referred to, and the inflight refuelling boom were the external recognition differences between the A-4A and the A-4B. The A-4B production run totalled 542 aircraft.

Saratoga-based A-4B's of VA-34 starting their break to the carrier. (Photo: U.S.N.)

A long legged A-4C of VA-192 picks up the cable.

As a result of operational experiences, the ever increasing requirements dictated by the "cold war" and the updating of the "state-of-art," new light attack requirements were established in 1957. Greater ranges through foul weather and shrouded terrain were needed. Radar and autopilot were needed to penetrate these areas. A proposal was submitted for an aircraft designated A4D-3 to fulfill these requirements. In addition to installation of sufficient avionics to satisfy the all-weather requirements, the Pratt and Whitney J52 engine was to be substituted for the Curtiss Wright J65 to enable the obtaining of lower fuel consumption, thus increasing the radius of action. Orders for four aircraft were let on a development contract; however, before the aircraft could be built the contract was cancelled. Rising costs of the avionics and new engine coupled with an austerity in Naval aircraft programs caused the suspension of the A4D-3.

In spite of the cost ceiling, the necessity for additional performance still existed. A compromise aircraft was developed retaining the J65 engine but adding a fairly sophisticated autopilot, a low altitude bombing-all attitude indicating gyro system, a terrain clearance radar system and an angle of attack indicating system. The A-4C (A4D-2N) as the

The "Rampart Raiders" of VA-212 deploy to the Far East on the carrier U.S.S. Hancock with their A-4E aircraft. (Photo: the author)

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aircraft was designated was first flown August 21st 1958, and became operational in February 1960. By the time this version was being superceded, 638 had been delivered to the Fleet by December 1962.

In mid-1959 an awareness of the importance of so-called "conventional warfare" was highlighted by the deployment of the U.S. Marines to Lebanon. Most of the aircraft in the U.S. Military inventory at that time were developed with the primary intent of utilizing the family of atomic energy weapons developed since the termination of World War II. Studies indicated that the A-4 aircraft, already built in dual capacity, as an "A-bomber" or conventional weapon carrier could be further improved. The three wing external store hard points could be increased to five with some structural beef-up. The Pratt and Whitney J52 engine was sufficiently developed to warrant the necessary forward fuselage redesign to install in the Skyhawk airframe. The installation of this engine would allow the bantam bomber to carry 2,000 pounds of bombs 700 miles, perform its mission and return 700 miles to its base. This version, the A-4E or A-4D-5, was given the go-ahead July 30th 1959 by altering the existing A-4C contract to change the last two A-4C airframes to the new configuration. First flight occurred July 12th 1961 and the aircraft became operational in December, 1962 with delivery to the "Black Knights" of VA-23, an attack squadron of the Carrier Air Wing Two/carrier *U.S.S. Midway* team.

During the service life of the Skyhawk, the design engineers were constantly striving to improve the aircraft. For example: the ejection seat designers had come up with a design that would safely eject a pilot from the aircraft at zero forward velocity and zero elevation thus materially reducing the chances of injury to the pilot on malfunctions at takeoff or landing. To improve the crosswind landing characteristics of the A-4, the addition of spoilers to the top surface of the trailing edge of the wing were recommended. The purpose of these spoilers was to destroy the lift and securely plant the aircraft on the runway during a landing in which the wind direction was not favourable. Also, the addition of nose wheel steering was suggested for better control during crosswind taxying and taxying in limited spaces. The electronic engineers were always ready to provide improved products. The Douglas Company had suggested to the U.S. Navy that either a two place version or conversion of the single place A-4 aircraft for combat training was not only feasible but advisable, in order to facilitate the combat syllabus training of

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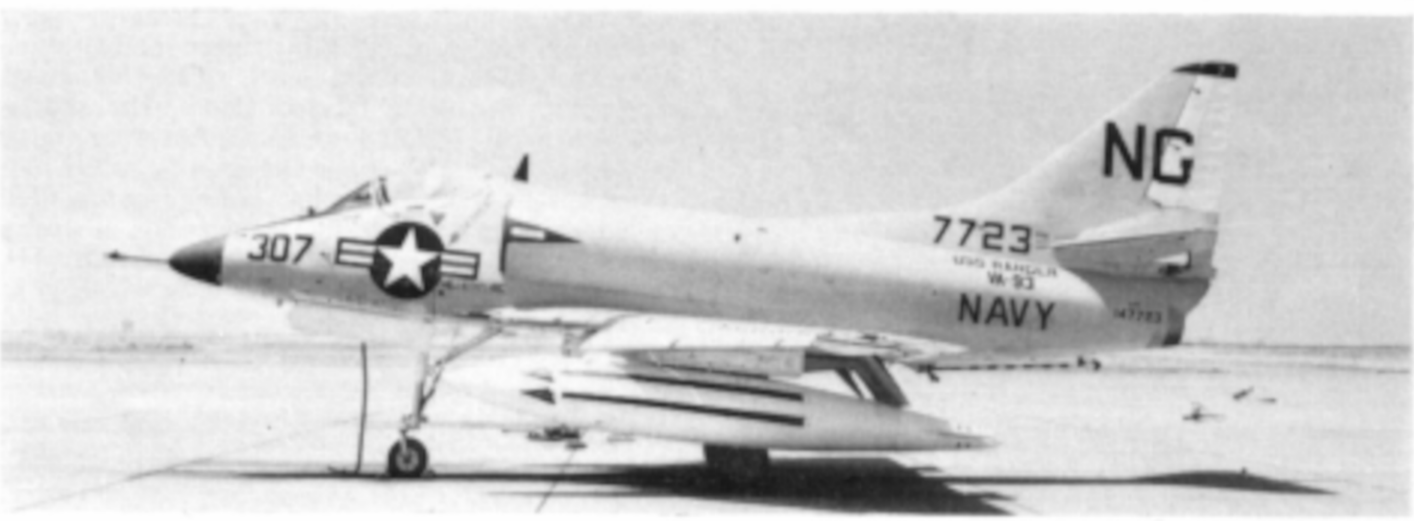
All U.S. Marine light attack squadrons are equipped with A-4 aircraft. VMA-332 is currently flying the A-4E version.
(Photo: B. Donato)

An A-4C from VA-66, tanker configured, taxying forward for positioning for a catapult launch.

VA-112's A4D-2N aircraft flying over the mountains of California.

The "Blue Blazers" of VA-93 were the first Pacific Fleet squadron to operate the A-4 aircraft. Later they transitioned to A-4B and now fly the A-4C Skyhawks.
(Photo: the author)



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The "Rampagers" of VA-83 have used all of the versions of the A-4 Skyhawk. Shown is an A4D-2 operating aboard the U.S.S. Forrestal in the Mediterranean in late 1959. (Photo: U.S.N.)

VA-23 operating from the U.S.S. Midway was the first unit to receive the A-4E Skyhawks. (Photo: the author)

The first skipper of VA-46 was a Scotsman, as shown by the markings of the A4D-2N.

Firing air-to-air missiles is part of the function of the A-4 series aircraft.

the attack pilots. In 1964 the Navy wrapped all of these suggestions into a single package and the resulting product became the TA-4E. Shortly after first flight occurred on June 30th 1965, the U.S. Navy redesignated this version to the TA-4F. Orders were initially placed for 35 aircraft which included altering the A-4E contract to specify that the last three aircraft be delivered trainer configured. Options were also placed for additional aircraft at that time.

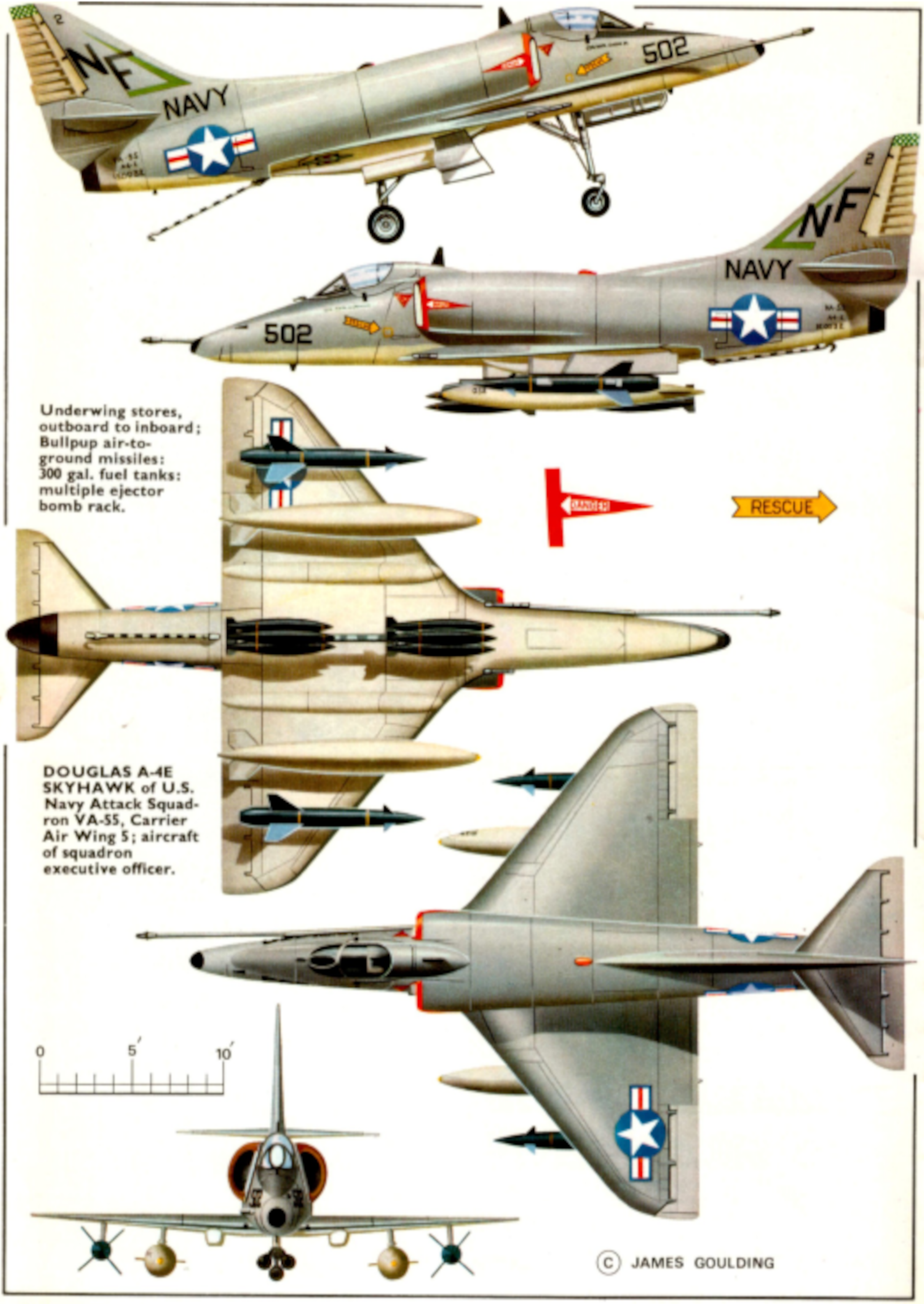
Whether the TA-4F will be the last version of the Skyhawk remains to be seen. While the first airplane was initiated in 1952, the subsequent models have been materially improved such that the aircraft still remains the top proven light attack aircraft available.

SKYHAWK CONSTRUCTION

The arrangement of the Skyhawk is conventional. The low wing is a modified delta planform of low aspect ratio, with ailerons, split flaps, aerodynamically operated leading-edge slats, and on the TA-4F only, landing wing-lift spoilers. The wing has three one-piece spars with spanwise stiffened skin, continuous from tip to tip. Most of the wing area between the spars contain an integral fuel tank with a 560-gallon capacity. The small span wing negates the need for folding wings such that are usual on carrier based aircraft in order to fit on the elevators that transport the plane from below deck to the main deck. The non-folding configuration saves weight and complexity in joints and fold mechanism, promotes safety and minimizes maintenance. Plainview taper of the wing box, coupled with stringer configuration, afford a constant stress level which eliminates requirement for using tapered skin. The skin is ·064 inch thick, 27 feet long and 8 feet wide and is one of the largest thin-gauge sheets to be rolled.

The landing gear retracts forward eliminating need for emergency extension systems since the airstream force will lock the gears down after free fall. The landing gear appears to be rather long which gives the aircraft an unusual appearance. However, this device facilitates ground clearance while rotating on takeoff.

The fuselage structure is of all-metal, semi-monocoque construction, and is built in two major assemblies. The forward fuselage assembly includes the nose electronic compartment, cockpit, engine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Underwing stores, outboard to inboard; Bullpup air-to-ground missiles: 300 gal. fuel tanks: multiple ejector bomb rack.

DOUGLAS A-4E SKYHAWK of U.S. Navy Attack Squadron VA-55, Carrier Air Wing 5; aircraft of squadron executive officer.

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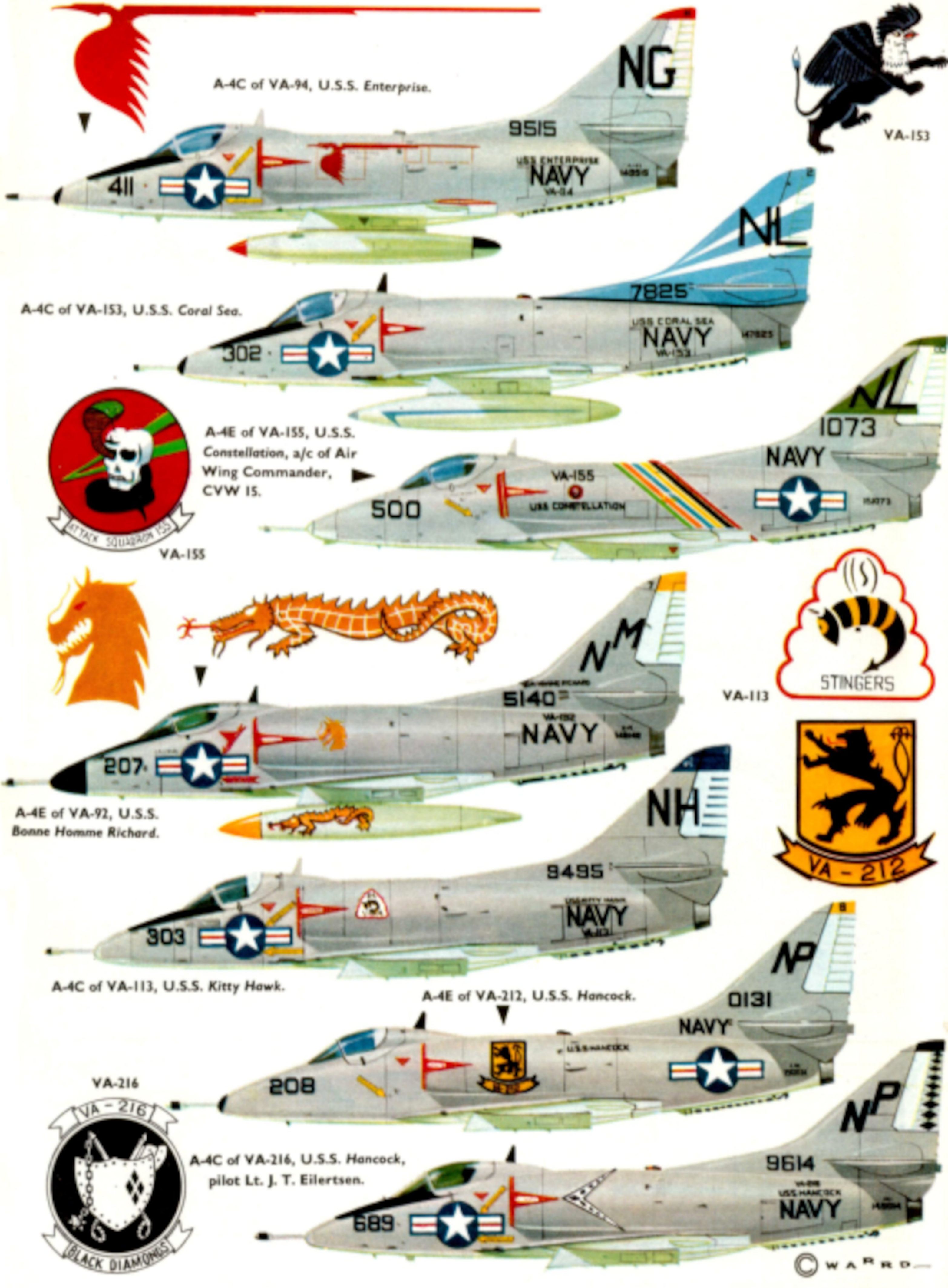

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A-4C of VA-94, U.S.S. *Enterprise.*

A-4C of VA-153, U.S.S. *Coral Sea.*

A-4E of VA-155, U.S.S. *Constellation,* a/c of Air Wing Commander, CVW 15.

A-4E of VA-92, U.S.S. *Bonne Homme Richard.*

A-4C of VA-113, U.S.S. *Kitty Hawk.*

A-4E of VA-212, U.S.S. *Hancock.*

A-4C of VA-216, U.S.S. *Hancock,* pilot Lt. J. T. Eilertsen.

support sections, and a self-sealing fuel tank aft of the cockpit and between the engine air inlet ducts. The fuselage aft section houses the engine tail cone and tail pipe, supports the speed brakes and empenage control surfaces, and is easily detached for engine removal.

The cockpit achieves maximum internal space yet maintains minimum external shape. This paradox is achieved by the use of heavy skin without internal stiffeners. Flak protection is also gained by this device.

The ejection seat is the Douglas designed "escapac" which, in various versions, is used on many other aircraft. The I-C3 seat used in the TA-4F features zero altitude, zero speed capability in that an additional margin of safety is provided by a ballistic parachute which achieves canopy deployment four times as fast as conventional methods. An explosive charge fires the parachute out to the length of the shroud lines and a second charge opens the canopy by ejecting 14 weights attached to the skirt, attaining full parachute deployment in less than half a second.

A self-sealing tank behind the cockpit bulkhead extends to the forward end of the engine compartment. This tank is deleted on the two-place version. However, a faired-in saddle tank installed on top of the aft fuselage is optional and can be used.

The aft fuselage construction is similar to the forward fuselage in that stiffened skin consisting of light channels with two Z-section vertical stiffeners spaced between them is used. The fin and dorsal surface are built integral with the fuselage.

All control surfaces with the exception of the rudder are constant chord. From the A-4B version and later all control surfaces are actuated by the use of a dual tandum hydraulic actuator feed by two separate sources. The failure of one system does not render the controls inoperable. In the event of both hydraulic systems failing, the elevator and aileron power cylinder can be mechanically disconnected from the

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VA-113 converted to A-4 Skyhawks in 1957 and have been a key member of Carrier Air Wing II. (Photo: the author)

An A-4E from VA-83 demonstrating the varied load that can be delivered to the enemy. (Photo: U.S.N.)

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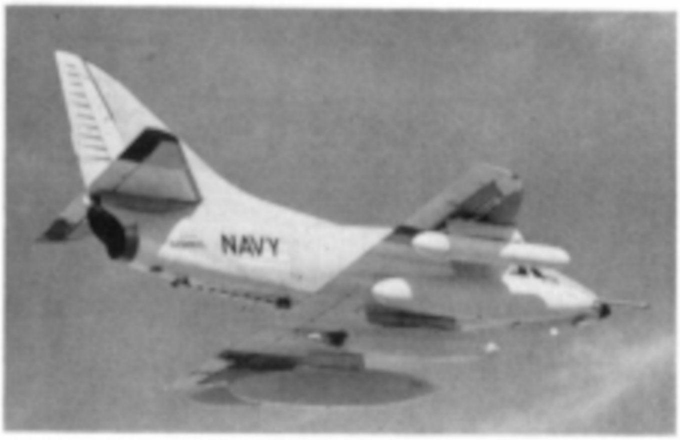
The "Blue Tail Flys" of VA-153 are currently operating their A-4C aircraft from the U.S.S. Coral Sea. (Photo: the author)

system, thus allowing reversion to manual control.

The tricycle landing gear, nose wheel steering and spoilers on later versions and fuselage speed brakes are hydraulically operated. An electrically operated, fully adjustable horizontal stabilizer is used for trim throughout the normal flight range. The ailerons, elevators, and rudder are operated by dual hydraulic power systems. An air-driven, drop-out emergency generator is available in case of power failure.

The power plant for the A-4A, A-4B and A-4C series is the Curtiss Wright J65 Sapphire engine rated at 7,700 pounds thrust in the J65-W-16A version. The A-4E and TA-4F aircraft use the Pratt and Whitney J52 engine with 8,500 pounds thrust for the A-4E version and 9,300 pounds static thrust rating for the J52-P-8A used in the TA-4F.



The five wing station configuration of the A-4E series was flight tested on this modified A4D-2N, normally a three station aircraft.

An A4D-2 of VA-81 ready for a "cat" shot. (Photo: U.S.N.)

The navigation, communications and identification equipment has been consolidated into a single nose mounted unit. Removal of this sealed unit takes a single mechanic only a few minutes. Only a single outlet cable facilitates hook-up. It was estimated that approximately 50 pounds of weight was saved by this method of construction.

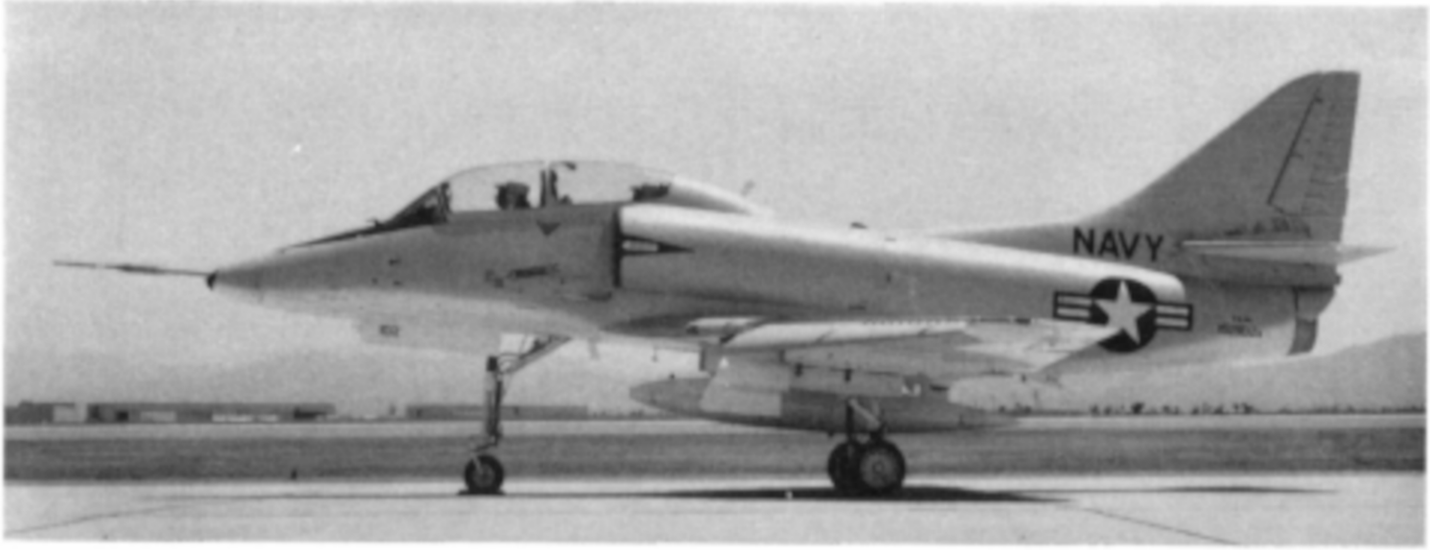
Two 20 mm. guns are installed in the wing roots, each with 100 rounds of ammunition. A wide variety of ordnance, cluster and separate bombs, gun pods, air-to-air or air-to-ground missiles, rockets, fuel tanks and special mission stores can be carried on the three wing stations on the A-4A, A-4B and A-4C aircraft and five wing stations on the A-4E and TA-4F.

The Skyhawks are fully aircraft carrier qualified. They retain the catapult and arresting hooks for land based operations which are typified by the U.S. Marines Short Airfield for Tactical Support (S.A.T.S.) operation. The arresting hook is also available in emergency field arrestments.

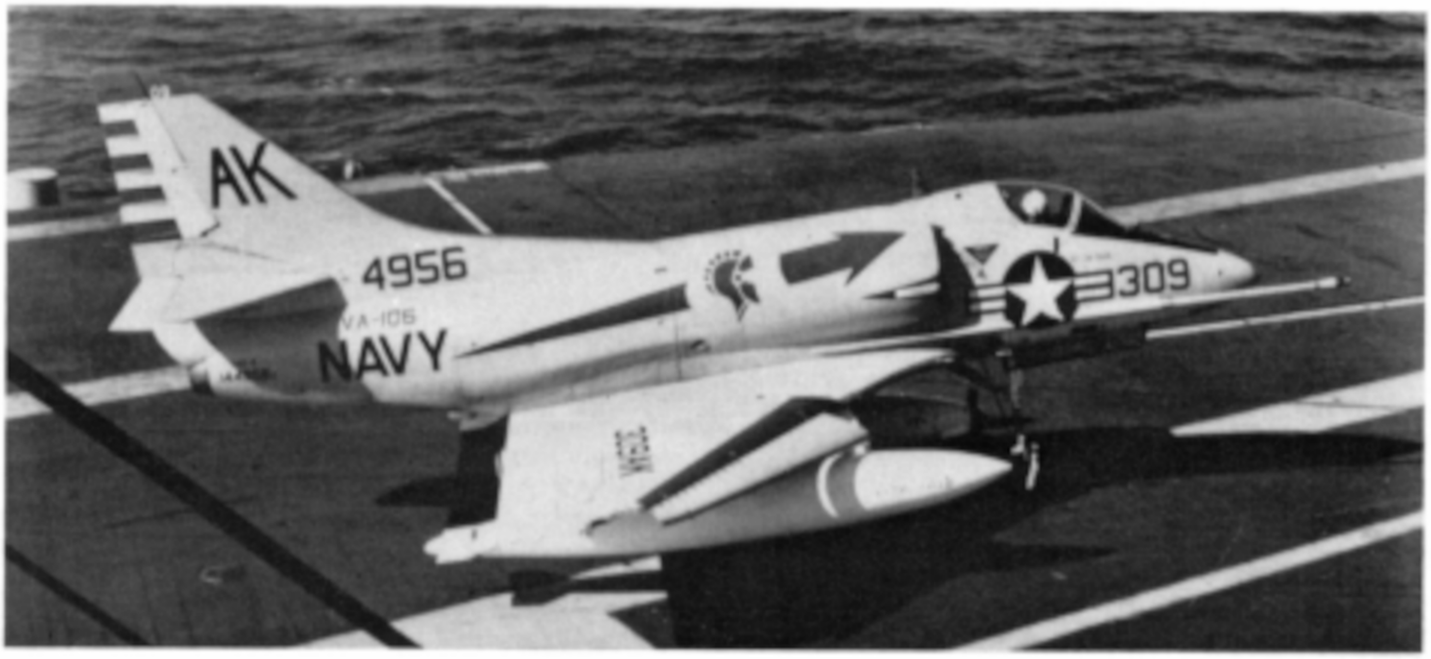
Two A-4C aircraft were modified to improve their rough field operating characteristics and then demonstrated to the U.S. Army. The modifications consisted of dual wheel landing gear installation and installation of a 24-foot diameter drag chute. After completion of the evaluation trials, the two aircraft were converted to standard configuration and delivered to the Fleet.

OPERATIONAL HISTORY

After rugged B.I.S. (Bureau of Inspection and Survey) trials at the Naval Air Test Centre at Patuxent River, the A4D-1 was assigned to VA-72 in order to complete the Atlantic Fleet trials. VA-72 had flown F9F Panthers during the Korean War and had only recently been reassigned the attack role. The Hawks, as they became known, subjected the A-4's to a round-the-clock operation to bring to the surface any design or maintenance shortcoming. VF (AW)-3 in the Pacific Fleet was assigned the same task. At the conclusion of this Flight Indoctrination Program (F.I.P.), VA-72 became the first operational A-4 squadron. In the Pacific Fleet, the Blue Blazers of VA-93 were being instructed by VA-125, the Replacement Air Group (R.A.G.), on the characteristics of the A-4 and they became the first AirPac operational Skyhawk unit. Like VA-72, VA-93 had



The number one TA-4E in the flight test configuration prior to first flight.



The "Gladiators" of VA-106 and CVW-10 normally deploy with the Atlantic Fleet. (Photo: U.S.N.)

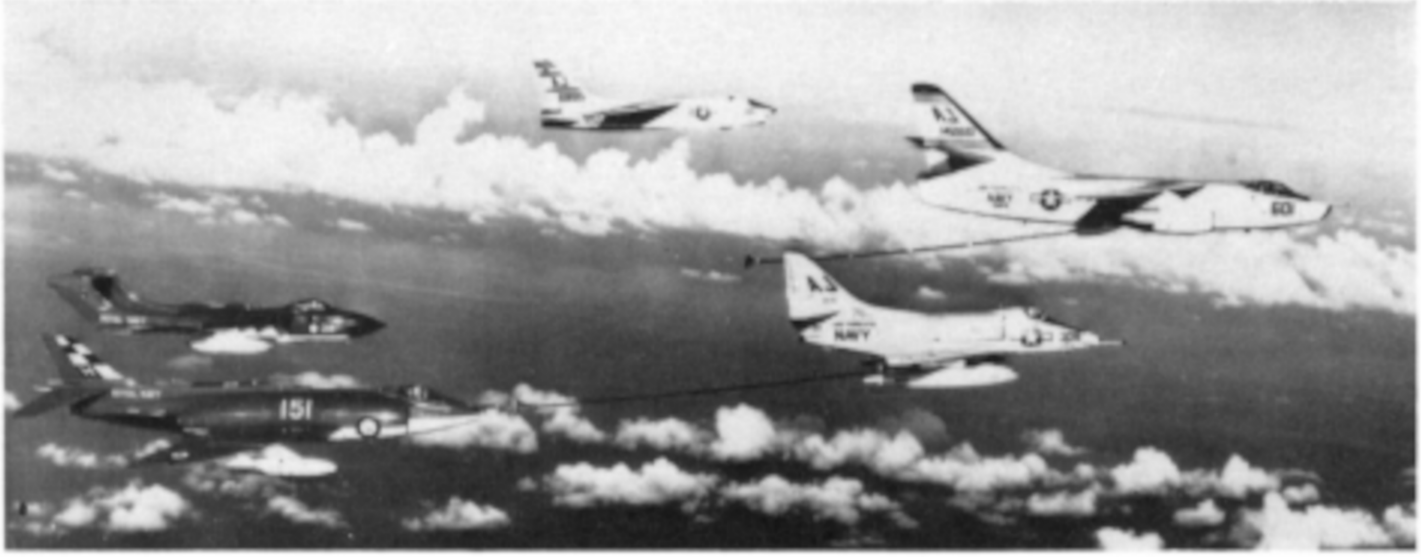
just been redesignated from a fighter squadron flying F9F-8 Cougars.

The U.S. Marines soon began to assimilate the Skyhawks into their operating inventory when VMA-224 based at El Toro, California became the first to receive the A-4's in January 1957. VMA-224 was initially commissioned a fighter squadron in 1942 and flew F4F Wildcats, F4U Corsairs, F2H Banshees and upon redesignation as a Marine light attack squadron, F9F Panthers.

The improved A-4B Skyhawk's first fleet deliveries were made in September, 1957 to VMA-211. Tracing its history back to VF-4M of January 1937, redesignated VMF-2 in July 1937 and VMF-211 in July 1941, the squadron had flown biplane F3F's initially and later while flying F4F-3's became known as the "Defenders of Wake." They repeatedly repulsed Japanese attacks on the small Pacific atoll until completely overrun by sheer numbers. The VMA-211 actions were one of the few bright spots in the early U.S. activity against the Oriental onslaught.

VA-12 became the first Navy operational A-4B unit when they began receiving their aircraft in February 1958 while shore based at Cecil Naval Air Station. VA-12 also flew first squadron tests using the large 300 gallon external fuel tanks in place of the previously used 150 gallon tanks. Using the Douglas-designed buddy-store inflight refuelling system, VA-12 also pioneered night air-to-air refuelling.

The U.S. Marines again had first shot at a new series when VMA-225 based at Cherry Point, North Carolina was issued A4D-2N (A-4C) aircraft in March 1960. Shortly afterwards in May, VA-192 then flying FJ-4B Furies began re-equipping with A-4C's to be the first Navy operational unit. The "Golden Dragons," a part of the Air Wing 19/carrier *U.S.S. Bon Homme Richard* team, have made four WestPac cruises with the A-4C aircraft. The fourth cruise resulted in a thorough testing of the units past training when they were deployed against the North Vietnamese. Flying hundreds of missions, the A-4C's delivered their share of 5,000,000 pounds of ordnance expended by the Air Wing on enemy installations. VA-195, a sister Air Wing 19 squadron also equipped with A-4C aircraft flew over 2,500 combat sorties. To illustrate the toughness of the Skyhawk aircraft, VA-195's skipper took an anti-aircraft shell in the nose wheel and was required to make a nose wheel up carrier landing. Two days later the aircraft was making another strike against the



A Scimitar about to be refuelled by a A-4C of VA-83 while a Sea Vixen positions itself for a refill from an A-3B from VAH-5. RF-8A from VFP-62 observes.

Viet Cong forces. Another aircraft took five hits on separate occasions and still made it back.

Carrier Air Wing 2's VA-23 drew the honor of being the first operational A-4E unit when the "Black Knights" turned in their A-4B's in late 1962 for replacement. Two Far East cruises later, the quality of their training was put to the test when as a part of Task Force 77, the unit completed its third combat cruise since being activated in 1950.

The majority of the U.S.N. Fleet and Marine Squadrons have been deployed against the Viet Cong. They and the Douglas AD Skyraider have delivered by far the greater majority of ordnance on the targets of the North Vietnamese. The A-4 aircraft is flying more than 60% of the Navy's total combat strikes and while they are receiving the most hits from the guns of the enemy, their loss rate has been extremely low. The ruggedness of their construction, small size, and back-up manual flight control system has contributed to this amazing ability to return to the carrier to be ready for the next assigned strike.

EXPORT SALES

The export version of the Skyhawk will be supplied to at least two nations with good possibilities that other countries will recognize the advantages of the relatively inexpensive attack aircraft. The Australian Naval Air Arm has ordered ten aircraft for use on their carrier *H.M.A.S. Melbourne*. Two of these will be the two-place version while the remaining eight will be the single-place attack/fighter configuration.

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Bullpup A and B air-to-ground missiles being prepared for testing aboard a Naval Missile Center YA-4C. (Photo: the author)

The Argentine Air Force has placed orders for 50 aircraft to be supplied from the U.S. Navy surplus inventory. These will be the A-4B version and will be refurbished by the manufacturer for delivery starting in 1966.

© Harry Gann, 1966

60 per cent of the Naval combat missions in Viet Nam are being flown by two Douglas attack aircraft types, the A-1 Skyraider and the A-4 Skyhawk.

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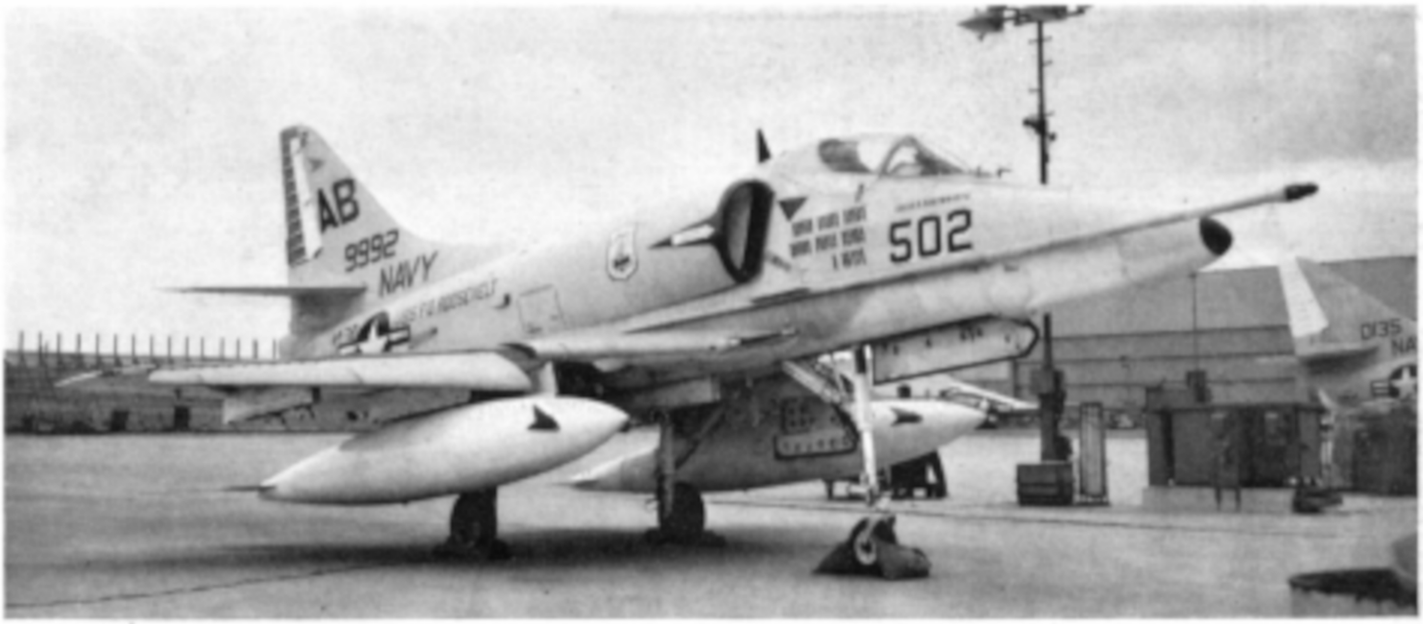
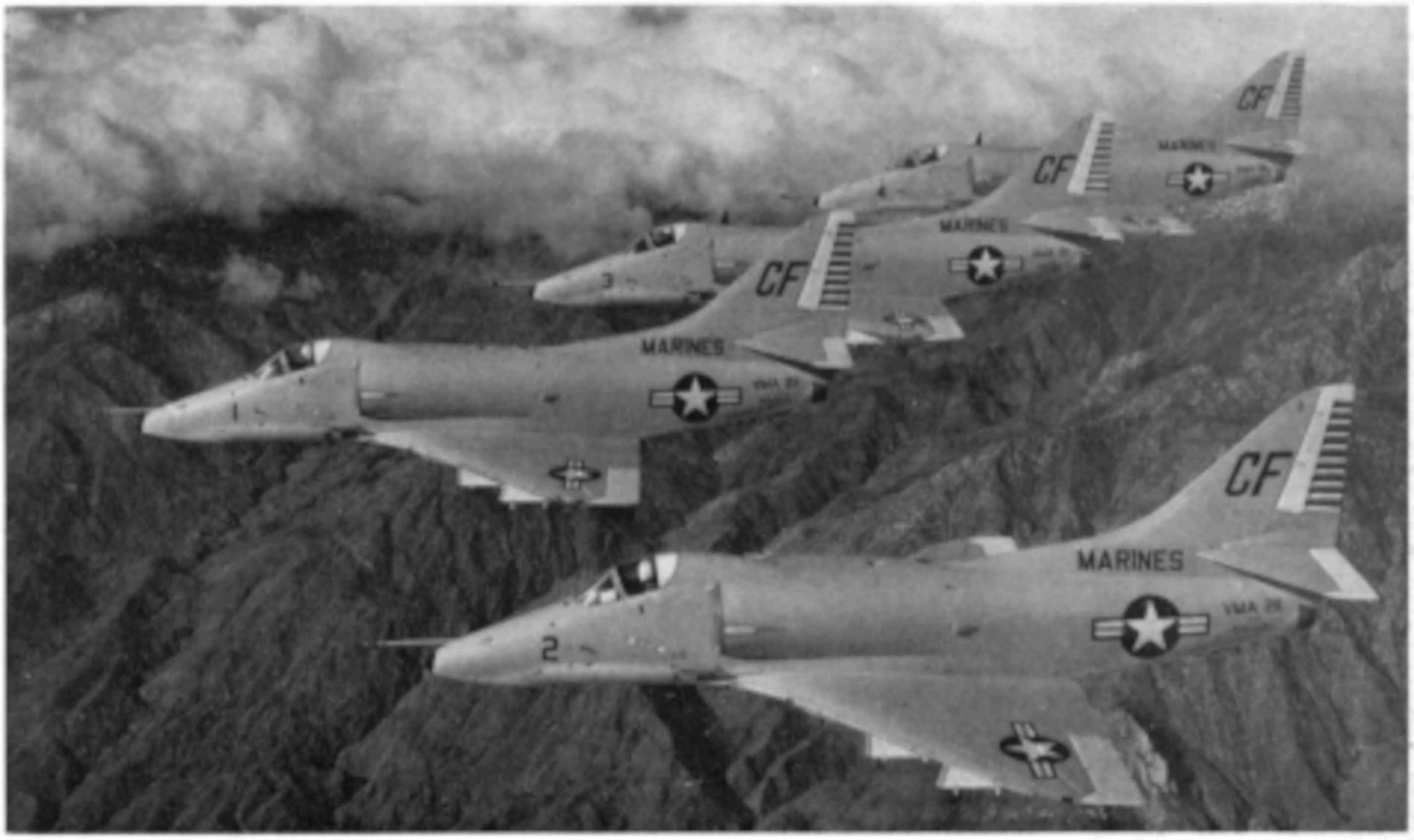


VA-72 shown in this picture with the markings of Carrier Air Wing 2, saw action in Viet Nam aboard the Carrier U.S.S. Independence as a unit of Carrier Air Wing 7. Note mission scoreboard under cockpit.

VMA-211's early pilots fought the Japanese at Wake Island with F4F-3 Wildcats. They now fly the latest version of the A-4 series.



GENERAL DATA					
	A-4A	**A-4B**	**A-4C**	**A-4E**	**TA-4F**
Span	27·5 ft.	27·5 ft.	27·5 ft.	27·5 ft.	27·5 ft.
Length*	39·0 ft.	39·4 ft.	40·1 ft.	41·3 ft.	42·5 ft.
Height	15·0 ft.	15·0 ft.	15·0 ft.	15·0 ft.	15·3 ft.
Wing Area ...	260 sq. ft.	260 sq. ft.	260 sq. ft.	260 sq. ft.	260 sq. ft.
Empty Weight ...	8,400 lb.	9,146 lb.	9,619 lb.	9,853 lb.	10,602 lb.
Max. T.O. Weight...	22,500 lb.	22,500 lb.	22,500 lb.	24,500 lb.	24,500 lb.
Engine	Wright J65-W-4	Wright J65-W-16A	Wright J65-W-16A	P & WJ52-P-6A	P & WJ52-P-8A
Max. Thrust ...	7,700 lbs.	7,700 lbs.	7,700 lbs.	8,500 lbs.	9,300 lbs.
Max. Speed, Clean...	577 K.M.I.	574 K.M.I.	564 K.M.I.	585 K.M.I.	574 K.M.I.

**Does not include inflight refuelling boom.*

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